JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. 13 MARCH 19, 1923 No. 6

SOIL CHEMISTRY.—*Relations between the active acidity and lime-requirement of soils.* EDGAR T. WHERRY, U. S. Bureau of Chemistry.[1]

The lime-requirement, or amount of lime needed to bring a soil to a neutral reaction, is decidedly less easy to determine with certainty than is the active soil acidity, or hydrogen-ion concentration of the aqueous extract (also sometimes termed soluble, effective, or "true" acidity). If any numerical factor could be discovered connecting the two, it would be possible to carry out the simpler acidity determination, and then to calculate from it the lime-requirement. From an indirect comparison of the active acidity and the lime-requirement of the same soils Blair and Prince[2] have concluded that more or less correlation between these quantities does exist; but they did not work out the direct relations, nor do any other writers appear to have done so. The matter seems of sufficient importance, however, to justify further study of the available data.

In what follows, lime-requirement will be expressed in parts of calcium oxide per thousand; this being numerically identical with tons per acre, if that area is considered as offering for treatment two million pounds of soil (corresponding to a depth of approximately 6 inches).

Hydrogen-ion concentration will be stated in the form of specific acidity, which has been defined by the writer[3] as the acidity of a solu-

[1] Presented at the Birmingham meeting of the American Chemical Society, April, 1922. Contribution from the Laboratory of Crop Chemistry.

[2] Soil Sci., 9: 253. 1920.

[3] Jour. Wash. Acad. Sci., 9: 305. 1920.

tion, measured by hydrogen-ion, with reference to the hydrogen-ion content of water as a unit. To transpose P_H values (which are hydrogen-ion exponents, not concentrations, though often erroneously so termed) into specific acidities, subtract from 7, and raise 10 to the power thus indicated. The great advantage of this method of statement is the ease with which the relative acidities of different solutions can be appreciated. For example, the P_H values of two of the soil extracts discussed later are 5.8 and 5.5; which of these is the more acid, and how much more? Considerable calculation would be necessary in order to answer these questions. When these values are subtracted from 7 they give 1.2 and 1.5 respectively; and raising 10 to these powers with the aid of a table of logarithms yields the specific acidities 15.9 and 31.6. It then takes but a glance to see that the second solution is practically twice as acid as the first. The use of this method is recommended to writers who desire to enable their readers to appreciate relative values of acidity with a minimum of effort.

RELATIONS TO BE EXPECTED

Is any correlation between specific acidity and lime-requirement to be expected? Let us consider what these two quantities represent. The writer's views as to their significance have already been published in another connection[4] but they would seem to require re-statement here in a somewhat different form. In the determination of lime-requirement, lime water is added to the soil until the mixture shows a neutral or somewhat alkaline reaction. The calcium hydroxide is used up in decomposing any aluminium or iron salts present; and in neutralizing soluble acids, (the hydrogen-ion of which is the source of specific acidity) insoluble acids or acid salts, and any hydrogen-ion which may exist adsorbed on the soil colloids,[5] (the place of which may then be taken by calcium-ion).

As decomposable aluminium or iron salts, (such as the chlorides, sulfates or citrates) or of insoluble acids (e.g. dihydroxystearic) have never been demonstrated to be present in normal soils in more than minute amounts, the lime used up by them must be inconsiderable. The amount of lime needed to neutralize the soluble acid represented by a specific acidity of even 1000 (P_H 4) has been repeatedly

[4] Ecology, 1: 160. 1920. Especially pages 167–170.

[5] It is now generally believed that the source of the electric charge on colloids lies in adsorbed ions, especially H^+ and OH^-. This matter is fully treated in modern books on colloid chemistry, and need not be discussed further here.

found to be, as would be expected, quite negligible (about lime-requirement 0.002). The conclusion seems necessary, therefore, that the bulk of the lime taken up by a soil goes to neutralize hydrogen-ion adsorbed on the colloids; or, in other words, the lime requirement is essentially a measure of the amount of adsorbed hydrogen-ion present in a given soil.

The ratio between adsorbed hydrogen-ion (lime-requirement) and soluble hydrogen-ion (specific acidity) accordingly depends on the quantity and character of the colloid matter present. If several soils contain approximately the same amount of essentially identical kinds of colloid, then this ratio should be the same for all of them; a correlation between specific acidity and lime-requirement could be said to exist, and, provided the ratio has been determined in one instance, the lime-requirement could be calculated from observed values of specific acidity for this whole series of soils.

Data on gravelly loam soils.—All four soils discussed by Blair and Prince in the paper cited were considered to belong to the same soil type, Sassafras gravelly loam. To ascertain whether the ratio between specific acidity and lime-requirement is the same for all of them, these two quantities should be compared with one another directly. To this end, specific acidity values have been calculated from the P_H by the procedure above given, and lime-requirement values in tons have been obtained by dividing the number of pounds of CaO by 2000. The ratio between these two values may be simply and conveniently expressed in the form of a correlation coefficient, appropriately designated by the initial letter of the word colloid, C; this is the factor by which specific acidity (S.A.) must be multiplied to obtain lime-requirement (L.R.), that is, $L.R. = C \times (S.A. - 1)$. In this connection it should be noted that since the value of the specific acidity at the neutral point is 1, not zero, 1 is subtracted from S.A. in all calculations. It may also be remarked that the writer fully realizes that the uncertainty of measurements of P_H and especially of L.R. does not justify placing much dependence on the values of C beyond the second decimal place.

The specific acidity of these soils was found to range from 2.0 to 39.8, the lime-requirement from 0.05 to 0.8, and C from 0.010 to 0.200. The lower values of C represent untreated soils, the higher, those treated with lime. This is interesting from the theoretical standpoint, for it means that the ratio between soluble and adsorbed hydrogen-ion, and accordingly the character of the soil colloids, varies widely,

even among soils of similar aspect. But it indicates at the same time that it is impracticable to calculate lime-requirement from specific acidity without knowing exactly what soil is under consideration in each case.

Data on cranberry bog soils.—It now seemed desirable to ascertain whether other types of soils would yield results similar to the foregoing; and certain of the data presented by Joffe[6] were used for this purpose. This author plotted active acidity against lime-requirement in some cases, but as he used exponential values for the former, his correlations are not directly comparable with those of the present paper. On recalculating his data, the specific acidity was found to range from 1 to 1259, the lime-requirement from 0.1 to 7.5 and C from 0.004 to 0.200. There is a decrease in C with depth in the soil at a given spot. The relations thus correspond to those shown in the gravelly loam soils.

Data on a silt loam soil.—To obtain still further information upon the way in which the features in question vary from one soil to another, some data on an Ohio silt loam, published by Knight,[7] were used. (In this connection the writer wishes to state that he does not agree at all with the majority of Knight's conclusions.) The specific acidity observed ranged from 100 to 1140, the lime-requirement from 0.9 to 2.2, and C from 0.0015 to 0.0091. As in the other soils, the range in C is wide; but in this series of results it is brought out with special clearness that liming results in a marked increase in the value of C, although the effect varies to some extent with the differently fertilized soils, evidently because of the different ways in which the lime reacts with the compounds present.

Classification of soils on the basis of C.—The values of the correlation coefficient C for the whole series of soils above considered are collected in Table 1. They are arranged in a number of "classes," the typical value for each of which is made for convenience about twice as great as for the preceding one.[8] There are, of course, all gradations between these classes. It is evident that only if the class into which a given soil falls could be determined by some simple procedure, would it be practicable to obtain its lime-requirement from its specific acidity.

[6] Soil Sci., **9**: 261. 1920.

[7] Journal Ind. Eng. Chem., **12**: 559. 1920.

[8] In order to bring the values close to numerals the relationship of which is obvious, the multiple actually used is $\sqrt[3]{10}$ or 2.154. . . . The rounded-off numbers obtained thereby, in all decimal places, are 1, 2 and 5.

TABLE 1—SUMMARY OF VALUES OF COEFFICIENT C [L. R. = C × (S. A. − 1).]

SOILS STUDIED	NO.	DESCRIPTION	VALUES OF COEFFICIENT C		
			Range	Average	Class
Silt loam.....	6	Variously fertilized	0.0015–0.0020	0.0018	0.002+
	1	Manured	0.0022	0.0022	
Silt loam.....	5	Limed, in part	0.0037–0.0063	0.0053	0.005−
Mediacid peat.....	4	Cranberry bog	0.0040–0.0070	0.0055	
Silt loam.....	3	Limed, balance	0.0075–0.0091	0.0085	0.01
Gravelly loam.....	1	In part	0.010	0.010	
Gravelly loam.....	2	In part	0.019 –0.026	0.023	0.02+
	7	Limed, in part	0.018 –0.036	0.027	
Gravelly loam.....	3	Balance; limed, in part	0.038 –0.050	0.044	0.05−
Subacid peat.....	4	Cranberry bog, depths	0.036 –0.064	0.047	
Subacid peat.....	2	Cranberry bog, others	0.076 –0.077	0.077	0.1
Gravelly loam.....	3	Limed, in part	0.076 –0.136	0.100	
Subacid peat.....	2	Limed, balance	0.166 –0.200	0.183	0.2+
Gravelly loam.....	1	Limed, balance	0.200 –	0.200	

Since this paper was prepared, over a year ago, a new series of comparisons of lime-requirement and active acidity has been published by Harlan W. Johnson.[9] On calculating the coefficient C for his data, the following classes are found to be represented:

TABLE 2

Fine sandy loam...	1	Knox	0.007–	0.007	0.005
Fine sandy loam...	1	Buckner	0.015–	0.015	0.01
Various loams.....	7	Lindley, O'Neill, etc.	0.023–0.035	0.028	0.02
Various loams.....	10	Plainfield, Shelby, etc.	0.037–0.070	0.050	0.05
Various loams.....	10	Buckner, Tama, etc.	0.077–0.121	0.086	0.1
Various loams.....	7	Judson, Marshall, etc.	0.166–0.301	0.234	0.2
Various loams.....	2	Wabash, Waukesha.	0.378–0.588	0.483	0.5
Various loams.....	2	Hancock, Bremer	0.9 –2.5		high

Again the values of C show a wide range. This author furnishes data on organic matter present in these soils, and it is interesting to find that on plotting the values of C against the organic matter, they are found to be on the whole proportional; it is also striking that the lime-requirement itself is a function of the organic content, averaging one-sixth of the latter. These relations indicate that the organic

[9] Soil Sci., 13: 7. 1922.

colloids are more important than the inorganic in furnishing hydrogen-ion to be neutralized by lime. The lack of relation between P_H and organic matter is not opposed to this, for the amount of organic acids needed to yield the P_H values shown is infinitesimal in comparison with the total organic content.

Summary.—In this paper lime-requirement is stated in parts per thousand of CaO; and, because of the ease with which relative values can be appreciated, active soil acidity is stated in the form of specific acidity. The ratio between these in a given soil may be expressed by a correlation coefficient C obtained by the equation: L.R. = C × (S.A. − 1). The value of C is believed to be a measure of the adsorptive power of the soil colloids for hydrogen-ion.

The coefficient C has been found to vary so widely from one soil to another, from an untreated to a limed soil, and even from one depth to another in the same soil, that it is impracticable to calculate lime-requirement from acidity determinations in general, as has been proposed. Soils may be roughly classified on the basis of the value of C, a convenient ratio between classes being $\sqrt[5]{10}$; but only if some simple procedure is first devised for classifying a given soil can there be obtained from its specific acidity a value for its lime-requirement.

BOTANY.—*Two new genera related to* Narvalina. S. F. BLAKE, Bureau of Plant Industry.

The type species of *Narvalina, N. domingensis* (Cass.) Less., is a shrub known only from the island of Hispaniola (Santo Domingo) in the West Indies. It is closely allied to the widespread and variable genus *Bidens* to which our "sticktights" or "devil's pitchforks" belong, being distinguished chiefly by its shrubby habit, coriaceous leaves, and wing-margined achenes. Although still rare in herbaria, at least in this country, it is represented in the National Herbarium by two sheets of excellent specimens collected by Mr. Emery C. Leonard, who accompanied Dr. W. L. Abbott on a collecting trip to Haiti in 1920.

Up to 1900 only the original species had been referred to the genus. In that year three new species were described from Ecuador by the German student of Asteraceae, Georg Hieronymus. All three are now represented in the U. S. National Herbarium by fragments of the types recently received from Berlin. Study of these fragments, consisting of fruiting heads accompanied by portions of the leaves, shows that they represent two rather remarkable new genera.

One of these, to which belong *Narvalina corazonensis* and *N. homogama* of Hieronymus, includes also the Peruvian plant lately described as *Bidens mirabilis* Sherff. Dr. Earl E. Sherff, who has been occupied for some years in a revision of the genus *Bidens*, ascribed his new species to that genus with some hesitation, and as the result of renewed study of the plant has come independently to the conclusion that it must be distinguished generically. The new genus, which it is proposed to name *Ericentrodea*[1] in allusion to its numerous pappus awns, is accordingly published jointly by Dr. Sherff and the writer. It is distinguished from *Narvalina* by having the achene distinctly contracted at apex into a short neck or collar produced, at least in two of the species, into two very short branches each bearing about 3 to "8" fragile, retrorsely hispid awns. It differs from *Bidens* in the same features, as well as in the presence of achene wings, which, however, are nearly obsolete in *N. homogama*, or even completely so in *B. mirabilis*.

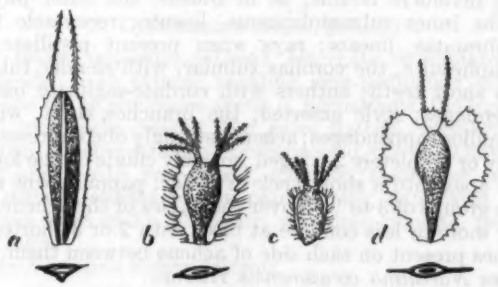

Fig. 1. *a*, achene of *Narvalina domingensis* (Cass.) Less. (*Leonard* 4832); *b*, *Ericentrodea corazonensis* (Hieron.) Blake & Sherff (*Sodiro* 44/2); *c*, *E. homogama* (Hieron.) Blake & Sherff (*Sodiro* 44/1); *d*, *Cyathomone sodiroi* (Hieron.) Blake (*Sodiro* 44/3). All × 3.

The other genus, represented only by *Narvalina sodiroi* Hieron., has a very broadly winged achene (similar in aspect to that of *Verbesina*, but obcompressed), bearing a pappus consisting of 2 very fragile awns and a turbinate spinulose-ciliolate corona about 1 mm. high, often adnate to the wings.

The distinctive characters of the three genera here considered are given in the following key.

[1] ἐρί, *much*, κεντρωδης, *prickly*.

Achene not contracted at apex; pappus of 2 awns only.....1. *Narvalina.*
Achene contracted into a neck or collar at apex.
Pappus of about 6 to 15 awns, more or less distinctly aggregated in two groups over the angles of the achene.....2. *Ericentrodea.*
Pappus of 2 awns and a turbinate corona.....3. *Cyathomone.*

1. **Narvalina** Cass. Dict. Sci. Nat. **38:** 17. 1825.

Needhamia Cass. Dict. Sci. Nat. **34:** 335. 1825. Not *Needhamia* R. Br. 1810.

1. NARVALINA DOMINGENSIS (Cass.) Less. Syn. Comp. 234. 1832. Fig. 1, *a.*
Needhamia domingensis Cass. Dict. Sci. Nat. **34:** 336. 1825.
Narvalina fruticosa Urban, Symb. Antill. **5:** 265. 1907, excluding *Bidens fruticosa* L., the name-bringing synonym.[2]
TYPE LOCALITY: Santo Domingo.
SPECIMENS EXAMINED: HAITI: Shrub 5 to 7 ft. high, occasional in arid thickets, vicinity of Pétionville, alt. 350 m., June, 1920, *Leonard* 4832 (U. S. Nat. Herb.); shrub 4 to 5 ft. high, scarce, vicinity of Fond Parisien, Etang Saumatre, May, 1920, *Leonard* 4098 (U. S. Nat. Herb.).

2. **Ericentrodea** Blake & Sherff, gen. nov.

Scandent shrubs or herbs (?), with opposite, petiolate, ternate or biternately divided, coriaceous leaves and cymose-panicled, discoid or radiate, yellow heads; involucre double, as in *Bidens*, the outer phyllaries small, herbaceous, the inner submembranous, lineate; receptacle flattish; pales flattish, membranous, lineate; rays when present pistillate, fertile; disk flowers[3] hermaphrodite, the corollas tubular, with slender tube, funnelform throat, and 5 short teeth; anthers with cordate-sagittate bases and ovate terminal appendages; style exserted, the branches short, with triangular, acuminate, papillose appendages; achenes strongly obcompressed, the obovate body distinctly or obsoletely 2-winged, coarsely ciliate on the lobulate margin, contracted at apex into a short neck or collar; pappus awns about 6 to 15, fragile, in two groups of 3 to "8" over the angles of the achene, those of each group usually more or less connate at base, with 2 or 3 shorter intermediate awns sometimes present on each side of achene between them.
Type species *Narvalina corazonensis* Hieron.

Heads radiate, in fruit about 1.7 cm. thick, 9 mm. high (corollas not included); lower leaves ternate, the upper simple..... 1. *E. corazonensis.*
Heads discoid, in fruit about 1 cm. thick, 6 mm. high (corollas not included); lower leaves biternate, the upper ternate or simple.
Heads with 20 or more flowers; lower leaves biternate, the terminal divisions unlobed; pedicels up to 3 cm. long..... 2. *E. homogama.*
Heads about 12-flowered; lower leaves biternate, the terminal segments trilobate; pedicels about 1 cm. long..... 3. *E. mirabilis.*

1. **Ericentrodea corazonensis** (Hieron.) Blake & Sherff. Fig. 1, *b.*
Narvalina corazonensis Hieron. Bot. Jahrb. Engler **29:** 49. 1900.
SPECIMEN EXAMINED: ECUADOR: Subandine woods, Mount Corazón, altitude 2,000 meters, *Sodiro* 44/2 (fragments of type coll.; U. S. Nat. Herb. no. 1,059,379).

2. **Ericentrodea homogama** (Hieron.) Blake & Sherff. Fig. 1, *c.*
Narvalina homogama Hieron. Bot. Jahrb. Engler **29:** 48. 1900.

[2] See Blake, Journ. Bot. Brit. & For. **53:** 13–14. 1915.
[3] The floral characters are drawn from material of *E. mirabilis.*

SPECIMEN EXAMINED: ECUADOR: Subandine woods, between Cotocallao and Nono, *Sodiro* 4[illegible]/1 (fragments of type coll.; U. S. Nat. Herb. no. 1,059,381).

3. **Ericentrodea mirabilis** (Sherff) Blake & Sherff.

Bidens mirabilis Sherff, Bot. Gaz. **61:** 496. *pl. 31.* 1916.

SPECIMEN EXAMINED: PERU: Humabalpa, November, 1857, *Spruce* 6273 (fragments of type coll. in Gray Herb. and herb. Sherff; photograph in U. S. Nat. Herb.).

Described by Spruce as a climbing herb, but probably, like the other species of the genus, either shrubby or suffrutescent. The heads examined have only young achenes. In these the awns, borne on a definite although short neck, are usually in two groups of 5 or sometimes 6 over the angles of the achene, agreeing in this respect with those of the other two species, but they do not seem to be united at base. In a few achenes, however, there were 2 or 3 shorter awns on each side of the achene between the main groups of awns. One achene examined bore altogether 15 awns, 5 each in the two groups and 5 smaller ones between them. From the appearance of some of the young achenes, it seems probable that a narrow wing is developed at maturity, at least in some cases.

3. **Cyathomone** Blake, gen. nov.

Shrub (?); leaves opposite, petioled, biternate or pinnate-ternate, membranaceous; heads 7 to 15, cymose, nodding, long-peduncled; involucre double, as in *Bidens*, the outer phyllaries about 5, herbaceous, the inner longer, submembranous; receptacle convex, the pales flattish, membranous, lineate; flowers unknown; achenes strongly obcompressed, the body narrowly obovate, contracted at apex, with two broad, ciliolate, somewhat pectinate-lobate wings, these usually adnate to the pappus cup; pappus of 2 very fragile retrorsely hispid awns and a turbinate, spinulose-ciliolate, persistent corona about 1 mm. high.

Type species *Narvalina sodiroi* Hieron.

1. **Cyathomone sodiroi** (Hieron.) Blake. Fig. 1, *d.*

Narvalina sodiroi Hieron. Bot. Jahrb. Engler **29:** 50. 1900.

SPECIMEN EXAMINED: ECUADOR: Subtropical woods along the Río Pilatón, *Sodiro* 44/3 (fragments of type coll.; U. S. Nat. Herb. no. 1,059,380).

The generic name, from *κναφος, cup,* and *μονη, an abiding,* refers to the persistent corona.

BOTANY.—*Three new plants of the family* Rubiaceae *from Trinidad.*

N. L. BRITTON, New York Botanical Garden, and PAUL C. STANDLEY, U. S. National Museum.

Study of a collection of plants received by the New York Botanical Garden as a loan from the Trinidad Botanic Garden has revealed material of many interesting plants, particularly some not previously recorded from Trinidad. Among them are the three species of

Rubiaceae here described as new. The two new species of *Urceolaria* are of special interest, since this genus is a very small one, and only two species have been known hitherto to occur in the West Indies.

Evea tontaneoides Britton & Standl., sp. nov.

Plants herbaceous, the stems slender (1 to 1.5 mm. thick), ascending or decumbent, densely pilose with slender whitish spreading multicellular hairs; stipule sheath greenish, 2 to 3 mm. long, densely pilose, the lobes two on each side, lance-linear, 3 to 4 mm. long, long-ciliate, pilose on the outer surface; petioles slender, 4 to 6 mm. long, densely pilose; leaf blades lanceolate, lance-oblong, or oblong-ovate, 3 to 6 cm. long, 1.5 to 2.5 cm. wide, acute or acuminate, rounded and often unequal at base, thin, above deep green, pilose with long, slender, apparently appressed hairs, beneath pale and similarly pilose; peduncles solitary in the forks of the branches, slender, densely pilose, about 3 cm. long, the flowers few, sessile in a dense head; bracts obovate or spatulate, 4 to 6 mm. long, acute or apiculate, green, sparsely pilose; calyx lobes linear, green, pilose; corolla (in bud) villosulous.

Type in the Herbarium of the Trinidad Botanic Garden, collected at Caparo, Trinidad, October 26, 1916, by W. E. Broadway (no. 9774).

A well-marked species, in habit strongly suggesting certain plants of the genus *Tontanea*, of the same family.

Urceolaria clusiaefolia Britton & Standl., sp. nov.

Branches stout, brown, angulate, somewhat lustrous, the internodes 2 to 8 cm. long; stipules quickly deciduous; petioles stout, 1 to 1.5 cm. long, glabrous; leaf blades oblong-obovate to obovate-elliptic, 8 to 11 cm. long, 3.5 to 5.5 cm. wide, acute, often somewhat abruptly so, at base acute or acuminate and decurrent upon the petiole, coriaceous, glabrous, lustrous above, the costa shallowly channeled, the lateral nerves evident and slightly elevated, beneath brownish, the costa and lateral nerves prominent, the latter about 8 pairs, ascending at an acute angle, anastomosing to form a continuous nerve remote from the margin, the ultimate nerves prominulous and irregularly reticulate; peduncle over 1.5 cm. long, stout, the involucre entire, about 3 mm. long; calyx spathaceous, in fruit about 1 cm. long, the immature fruit 5 to 6 mm. in diameter.

Type in the Herbarium of the Trindad Botanic Garden, collected on Mt. Tocuche, Trinidad, August, 1847, *Botanic Garden Herbarium* 673.

Although only imperfect specimens are available for study, these differ so conspicuously in leaf characters from the other West Indian representatives of the genus that it seems safe to assume that they represent a distinct species.

Urceolaria angustifolia Britton & Standl., sp. nov.

Branches stout, angulate, glabrous, brownish, the internodes 1 to 3 cm. long; stipules caducous; petioles 6 to 10 mm. long; leaf blades oblong-oblanceolate or narrowly oblong, 4.5 to 8 cm. long, 1.2 to 2.5 cm. wide, obtuse, cuneate at base, coriaceous, glabrous, lustrous above, the costa shallowly channeled, the lateral nerves evident and slightly elevated, beneath brownish, the costa and lateral nerves prominent, the latter about 11 pairs, ascending at a very acute angle, curving outward and anastomosing remote from the

margin, the ultimate nerves slightly elevated, irregularly reticulate; peduncles terminal, solitary, 2.5 cm. long, the involucre entire, 3 mm. high; calyx in bud 1 cm. long.

Type in the Herbarium of the Trindad Botanic Garden, collected on Mt. Tocuche, Trinidad, June 21, 1907, by William Leslie (no. 9363).

While this may be only a form of *U. clusiaefolia*, the shape of the leaves is strikingly different, and it is probable that the present plant is specifically distinct. Flowering specimens of both are a desideratum.

ENTOMOLOGY.—*A new* Reticulitermes *from the Orient.* THOMAS E. SNYDER, U. S. Bureau of Entomology.

Reticulitermes Holmgren was established in 1913 as a subgenus of the genus *Leucotermes* Silvestri. N. Banks, in 1920, raised *Reticiultermes* to generic rank. I am adopting the generic value given this genus by Banks, although I am doubtful as to whether *Reticulitermes* can be considered of generic rank. I place *Reticulitermes* in the family *Rhinotermitidae*, since the species have protozoa (Trichonympha) in the guts and subcordate pronota which would exclude them from the family *Termitidae* where placed by Banks.

Species of both the genera *Leucotermes* and *Reticulitermes* are extremely destructive to timber and other woodwork. Winged adults of species of *Reticulitermes* are dark colored, with the wings strongly reticulated, but with few hairs or marginal cilia; they are species of relatively northern distribution, the centre of distribution being North America. Species of *Leucotermes* are lighter colored, have the margins of the wings ciliate and are of relatively southern distribution. I have recently revised this genus.

Only two species of *Reticulitermes* are known from the Orient; these eastern species are *R. speratus* Kolbe and *R. flaviceps* Oshima, both being from Japan. The new species to be described is from China.

Reticulitermes chinensis, sp. nov.

Winged adult.—Head dark castaneous-brown (dark finished mahogany), smooth, shining, semi-quadrilateral, but rounded posteriorly, slightly longer than broad; at anterior of head above the ocelli are two prominent white spots (muscle attachments); head with dense, long, light yellow hairs. Fontanelle a small white point on a line connecting the backs of the eyes.

Antennae grey-brown with tips of segments whitish, 17–18 segments, pubescent; first segment clavate, elongate; second cylindrical, shorter; third very short, ring shaped; fourth twice as long as third; fifth more wedge shaped, slightly shorter than fourth; sixth longer than fifth; last segment elongate, sub-oval.

Eyes purplish, not quite round, not very prominent, separated from the lateral margins of head by a distance less than an eye diameter. Ocelli separated from eyes by a distance less than their small diameter.

Labrum yellow-brown, semi-tongue shaped.

Post-clypeus yellow-brown, much broader than long.

Pronotum about same color as head, smooth, shining, subcordate, not as wide as head, emarginate both anteriorly and posteriorly, raised up anteriorly, with long hairs.

Legs with femora greyish-brown, tibiae and tarsi yellowish.

Wings smaller than in *flavipes* and in the forewing the median vein is intermediate between subcosta and cubitus, whereas in *lucifugus* it is nearer to the cubitus.

Wing scale longer than pronotum, being 0.80 mm. in length.

Abdomen with tergites slightly lighter colored (more grey) than head, with long hairs; cerci three segmented; styli present in the male.

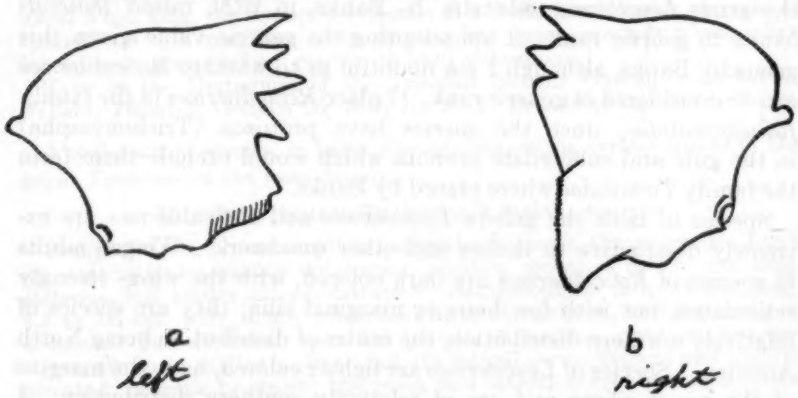

Fig. 1. Mandibles *a* left and *b* right, greatly enlarged

Measurements:

Length of entire winged adult: 9.15–9.40 mm.
Length of entire deälated adult: 4.8–5.2 mm.
Length of head (to tip of labrum): 1.25 mm.
Length of pronotum: 0.55 mm.
Length of hind tibia: 1.15 mm.
Length of anterior wing: 6.75–7.0 mm.
Width of head (at eyes): 1.15 mm.
Diameter of eye (long): 0.225 mm.
Width of pronotum: 0.95 mm.
Width of anterior wing: 1.90 mm.

From descriptions, *R. chinensis* is a smaller, lighter colored species than *R. speratus* Kolbe; the head is more hairy in *chinensis* and the teeth of the mandibles slightly different (Fig. 1); the ocelli are nearer to the eyes; the pronotum is not yellow. In the forewing the median vein is more intermediate between the subcosta and cubitus than in *speratus*. Winged adults of *chinensis* were compared with winged adults of *Reticulitermes lucifugus* Rossi from Talheiro, Maderia; of *R. flavipes* Kollar from the eastern United States;

and *R. claripennis* Banks from Kansas. *R. chinensis* is smaller than *lucifugus;* the ocelli are larger and the post-clypeus and the tibiae are more greyish-yellow colored, not so light castaneous; the post-clypeus is shorter and the fontanelle is smaller. *Chinensis* has not the yellow tibiae and tarsi of *flavipes*, ocelli are nearer to the compound eyes and the pronotum is smaller as is the entire insect. *R. claripennis* has lighter colored wings.

Soldier.—Head light yellow-brown, not twice as long as wide, ratio of length to width 1: 0.62–1: 0.63, sides parallel; with dense long hairs, rounded posteriorly. Eye spots indistinct if present. Gula slender, width at center being about one-half the width at the front. Mandibles dark castaneous with a reddish tinge, "S" shaped, incurved at tips; at base of left mandible two small marginal teeth—one sharp tooth and one small, broader, blunt (double?) tooth; right mandible with no teeth. The basal knobs of the mandibles are not regarded as teeth.

Antennae white with a yellowish tinge, with 16 segments, pubescent; third segment short, ring-like; fourth twice as long as third; fifth equals fourth; sixth longer; last segment elongate and sub-oval.

Labrum yellow-brown, narrow, pointed at apex, where there are long hairs.

Pronotum white with tinge of yellow, not as wide as head, nor not nearly twice as broad as long, emarginate both anteriorly and posteriorly, turned up anteriorly.

Legs white, with tinge of yellow, pubescent.

Abdomen white with tinge of yellow, with dense long, light yellow hairs.

Measurements:

Length of entire soldier: 4.9–5.4 mm.
Length of head with mandibles: 2.6–2.75 mm.
Length of head without mandibles (to anterior): 1.85–1.90 mm.
Length of left mandible: 1.5 mm.
Length of pronotum: 0.55–0.6 mm.
Length of hind tibia: 0.95–1.0 mm.
Width of head: 1.10–1.20 mm.
Width of pronotum: 0.85 mm.

The soldier of *chinensis* has a larger pronotum than that of *speratus* Kolbe, and the mandibles have slightly different marginal teeth; the soldier of *chinensis* has a longer, broader head than that of *flaviceps* Oshima.

Type locality.—"Suifu, Szechuen, (or Szechwan) China."

Described from a series of winged adults collected at the type locality May 1, 1920, and in 1922, by D. C. Graham. Soldiers with workers were also collected, at the type locality, in 1922 by D. C. Graham.

Type, winged adult.—Cat. No. 26043, U. S. N. M.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

BIOLOGICAL SOCIETY

SPECIAL MEETING

A special meeting of the Biological Society was held in the auditorium of the Interior Department on September 29, 1922, with President BAILEY in the chair and 240 persons present. Program:

DONALD R. DICKEY: *Exhibition of moving pictures of wild game of New Brunswick.* These pictures were taken on the upper waters of the Tobique River and across to the Nepisiguit. Views of the lakes and streams were shown, followed by numerous films of moose and deer, including many taken from a canoe. Both rapid and slow movement films were shown. Two of the most notable films showed ruffed grouse drumming. The bird could be seen to strike its wings together when drumming, both before and behind its body, which was in an erect position.

SPECIAL MEETING

A special meeting of the Biological Society was held at the Cosmos Club October 19, 1922, with the Washington Academy of Sciences and the Chemical Society of Washington, with President J. W. HUMPHREYS of the Washington Academy of Sciences in the chair and 94 persons present. Dr. H. J. HAMBURGER, Professor of Physiology in the University of Groningen, Holland, gave an address on the subject *The increasing significance of chemistry in medical thought and practice.*

642D MEETING

The 642d regular meeting of the Biological Society was held at the Cosmos Club November 11, 1922, with President BAILEY in the chair and 75 persons present. The program was as follows:

E. D. BALL: *Importance of adequate training for biological work in the Government service.* In the Government service at present, omitting Army and Navy, Indian Service, judges and attorneys, the number of men employed in some technical scientific line is 7074, of whom 4332 are actually engaged in their specialties. Of the latter, 2240 are in the Department of Agriculture and 2092 in other departments. In the whole Government service, scientific and other, the number of men who are paid salaries of $5000 and over reaches the total of 7761. Of these, 2490 are in the Civil Service. Four receive $25,000 or more; 183 receive $10,000 or more; 607 receive $7500 or more.

The following table of salaries of college professors was presented for comparison with that of scientific workers in the Government service.

In 7 leading endowed universities the range of salary for full professors listed in the graduate school was: minimum $4750, maximum $8550, average $5500.

In 7 leading state universities salaries range from $3200 to $7125, with an average of $4725.

In leading agricultural colleges $2850 to $4875, average $3750.

Of these faculties, 90 per cent in the first group had doctors' degrees, with a smaller percentage in the state universities, and still smaller in the agricultural colleges.

In the Department of Agriculture figures were obtained from four bureaus only. It was found that the average salary of men with doctor of philosophy degrees was $3372, with masters' degrees $2905, and with bachelors' degrees $2535. In connection with these figures, the speaker noted that many of the older men do not have the higher degrees, but have attained higher salaries through experience and seniority, so there would be a wider difference between the holders of different degrees, if only men of equal age and experience could be compared.

In conclusion, the speaker said the three objects of graduate study are the following: (1) to broaden the field of view; (2) to come in contact with great minds; and (3) to learn methods of research in the specialty involved.

G. N. COLLINS: *Maize and its wild relatives* (lantern). Maize is the only cereal whose wild prototype is unknown. The only wild plant known which is close enough to maize to give a clue to the origin of the latter is teosinte, a large Mexican grass of the genus *Euchlaena* There are two species, one perennial, the other annual. The latter hybridizes freely with maize, and all intergrades can easily be produced, but none of them maintain themselves in nature. Teosinte is a more highly specialized grass than maize, hence evolution must have gone backward if teosinte changed into maize. The theory that maize may have originated from teosinte by crossing the latter with some unknown plant similar to sorghum seems to accord best with the known facts.

N. A. COBB: *Nematodes inhabiting trees* (lantern). After a general account of nematodes or nemas, the speaker described in detail an outbreak of nemas on the coconut palms in the Canal Zone and vicinity. The nema was found in the roots and in a certain cylinder of trunk tissue; the latter turning red has given the name "red ring" to the disease. As there was no way to destroy the nemas within the tree, the speaker had turned his attention to methods of infection, and had found that the large palm weevils carry the worms from tree to tree. The gathering and destruction of the weevils on a large scale is believed to have checked the spread of the attack.

643D MEETING

The 643d regular meeting of the Biological Society was held at the Cosmos Club November 25, 1922, with Vice-President HITCHCOCK in the chair and 76 persons present.

The following new members were elected: J. C. BRIDWELL, S. C. BROOKS, E. F. FRIBLEY, L. G. HOOVER, P. B. JOHNSON, and EDMUND PLATT.

L. W. STEPHENSON gave a short account of the discovery of cypress stumps in an ancient swamp opened in excavating for the new Hotel Walker on Connecticut Avenue. As examined by the speaker, the top layer showed a recent fill of 10 to 12 feet; below this 7 or 8 feet of clay, then 5 to 8 feet of swamp deposit, then gray micaceous sand 12 to 15 feet deep, the lowest 3 to 5 feet becoming gravelly. The swamp layer, which is of the Pleistocene age, is a peaty clay, containing cypress stumps and knees with some seeds, balls and scales. Only a few logs were horizontal, most of them being vertical and truncated a little above the base. When dry, the wood burns freely. The only tree occurring is *Taxodium distichum*, the bald cypress, the present range of which extends to within twenty miles of the District. The speaker thought the estimate of 20,000 to 30,000 years as the age of the deposit was far too little. He illustrated the strata by means of a chart.

Dr. C. L. MARLATT then proposed an alternative explanation of the occurrence of the stumps. He exhibited an outline map taken from an old city map, from which it appeared that a stream called Slack Creek once flowed into Rock Creek from the vicinity of Dupont Circle, draining a large swamp to the north and east, and traversing the very spot where the excavation is now in progress. He therefore maintained that recent filling would account for all above the swamp layer, and this itself would date from the early white settlement of the District, about 260 years ago. He had been informed by one of the shovelmen that an old brick wall encountered in the digging was on the same level as the tree stumps.

There was some discussion of the second theory, leading only to the conclusion that much would depend on the existence of the supposed layer of clay 7 or 8 feet deep above the swamp and below the admitted recent fill. Dr. MARLATT had not detected this, but Mr. STEPHENSON had.

L. O. HOWARD: *Some informalities about pioneer workers in medical entomology* (lantern). The speaker showed lantern slides of a large number of pioneer workers, giving interesting facts or anecdotes about each.

C. W. STILES: *Frequency of amoeba in man, and its significance in public health.* In the war zone there was a great meeting place for men of all nations, and it was anticipated that returning soldiers might be infected with the amoeba of dysentery to an extent which might endanger the whole population. A conference was held in Washington to discuss the matter before the soldiers returned. It was thought from figures obtained by Kofoid that there would be from 400,000 to 700,000 cases of the disease among the returned men. An extensive examination of various classes of the population was carried out to get a basis for comparison. A circular was sent to all hospitals and medical schools, inquiring if an increase had been observed in the disease as the men were returned. Only 4.5 per cent reported any increase. A total of 8029 persons in the general population were examined, of whom 333 were infected, or 4 per cent; of 196 immigrants, 25 per cent were infected; of 329 boys and girls in a school in the District of Columbia, 17 per cent; of 83 boys and girls in another school, between 8 and 9 per cent; of 1547 civilians, 13 to 17 per cent; of 2984 ex-soldiers who had not gone to Europe, 8 to 9 per cent; of 3536 soldiers who had been in Europe, 7.8 to 9 per cent; of 362 miscellaneous, 7 to 9 per cent. In these infected cases few showed symptoms of the disease, as they were evidently able to restore the infected tissue as rapidly as it was damaged. These were carriers rather than patients. A few years ago this distinction was not made, but now it is known to be of great importance. It appeared from the statistics collected that the returning men were no menace to the health of the country, as they were less infected than the population at home.

The disease is easily cured in early stages, but later on with much more difficulty, although a new remedy, a newly discovered drug, is able to reach the parasite in the lungs and liver, and promises to cure the chronic cases.

J. M. ALDRICH, *Recording Secretary.*

644TH MEETING

The 644th regular and 43d annual meeting of the Biological Society was held at the Cosmos Club December 9, 1922, with President BAILEY in the chair.

The following 53 members were elected: JOSEPH BECKER, NORWELL BELT, R. A. BOGLEY, Jr., D. L. BROWN, C. H. CALVIN, BILLIE CASS, R. G. CONGDON, A. D. DAUGHTON, P. V. DE LEON, W. S. DETWILER, E. F. DUCEY,

J. V. FLANAGAN, M. C. FLOHR, H. D. FREIGER, J. L. FRETZ, CHARLES GESCHICKTER, H. A. GILBERT, L. S. GORDON, ANNE HOF, N. S. HUBERT, J. R. B. HUTCHINSON, M. A. JOHNSON, T. J. KELLY, ROSE E. KUNDAHL, W. H. LAWTON, P. MAHONEY, A. D. MARKS, G. A. MCLAIN, J. E. MCLAIN, E. C. MYERS, M. A. NORIEGA DE SABLA, J. L. O'CONNOR, R. C. ORRISON, K. J. OSTERHOUT, HERNDON PHILLIPS, EDMUND POPE, MARY E. QUICK, Dr. J. W. ROBERTS, F. G. RILEY, Jr., H. E. ROONEY, IGNATIUS RUTKOSKI, BENJAMIN SEILER, W. W. SPURGEON, JAMES STEWART, T. D. STEWART, F. E. STUART, ELIZABETH V. WADDLEY, E. E. WALTER, IDA WECKERLY, F. R. WEEDON, AVIS M. WITHERS, A. A. ZAPOLSKY, and E. E. ZIEGLER.

The reports of the Recording Secretary, the Corresponding Secretary, and the Committee on Publications were read and accepted.

The following officers were elected for the coming year: President, A. S. HITCHCOCK; Vice-Presidents. J. W. GIDLEY, S. A. ROHWER, H. C. OBERHOSLER, E. A. GOLDMAN; Recording Secretary, S. F. BLAKE; Corresponding Secretary, T. E. SNYDER; Treasurer, F. C. LINCOLN; members of the Council, C. E. CHAMBLISS, H. C. FULLER, H. H. T. JACKSON, W. R. MAXON, A. WETMORE. The President announced the membership of the Committee on Publications as follows: C. W. RICHMOND, Chairman, J. H. RILEY, T. E. SNYDER.

On motion of Dr. C. W. STILES it was moved that a committee on zoological nomenclature be appointed to coöperate with the International Commission on Zoological Nomenclature.

S. A. ROHWER, *Secretary protem.*

THE BOTANICAL SOCIETY OF WASHINGTON

161ST MEETING

The 161st regular meeting of the Botanical Society was held at the Cosmos Club, Tuesday evening. October 3, 1922, at 8 p.m. President SAFFORD opened the meeting. The minute of the last preceding meeting were not read, owing to their absence and that of the Corresponding Secretary, 41 members and guests were present.

The Executive Committee presented the names of Mr. PHILIP BRIERLEY of the Federal Horticultural Board, and Dr. A. G. JOHNSON of the Bureau of Plant Industry as candidates for membership.

Under Brief Notes, Mr. C. R. BALL presented Dr. JOHN PERCIVAL'S lately published volume on *The wheat plant.* Mr. PIERCE announced the coming dahlia show of the Takoma Horticultural Club to be held October 6 and 7.

The regular program of the evening followed: Mr. N. G. TEODORO, Plant Pathologist of the Philippine Department of Agriculture and Natural Resources, spoke on *Philippine botany with special reference to the genus* Musa, followed by the *Present status of phytopathology in the Philippines.* The present knowledge of Philippine botany is due to the efforts of Prof. E. D. Merrill, Director of the Philippine Bureau of Science. He published the results of his findings in 1903. Little attention was given by the Spanish government to the study of the flora of the Islands. In fact the only work was the establishment of "The Flora and Forestry Commission" under the direction of Sebastian Vidal, which continued from 1876 till his death in 1889.

At the beginning of the 18th Century, Padre Hippolito Casiano Gomez, an Augustinian wrote an article in a native language on household remedies,

mentioning various plants. The greatest of the friar botanists was Padre Manuel Blanco, also an Augustinian. His work in Spanish, entitled Blanco's Flora de Filipinas, was first published in 1837. It is a work of 965 pages; the second and third editions were written after his death. Copies of all three editions, which are in the Department of Agriculture, were shown at the meeting. Most of the older herbaria in Manila were destroyed during or before the Insurrection; however two now remain, that formed by Regino Garcia in 1894, another collected by Dr. Leon Ma. Guerrero. The botanical libraries were also destroyed by fire about 1898.

Since the American occupation, real botanical work has progressed rapidly. With Prof. E. D. Merrill in 1903 were three other botanists, Dr. E. B. Copeland, Dr. H. N. Whitford, and Mr. A. D. E. Elmer, all of whom were attached to the Bureau of Government Laboratories. In 1905 this Bureau became the Bureau of Science. The herbarium of the Bureau of Science contains upwards of 200,000 specimens. The Philippine Journal of Science is the medium for publishing botanical articles. Quite a number of Filipino botanists received their training in the College of Agriculture, which was established in 1909, with Dr. Copeland as its founder and dean.

Mr. Teodoro began a classification of the genus *Musa* for the Philippine Government in 1915. He found the species not well defined, and in order to make a beginning in classifying them, he worked up the varieties. There are now about 600 varieties of bananas growing in cultivation at the College of Agriculture at Los Baños. The results of the classification of varieties have been published in *A preliminary study of Philippine bananas*, which appeared in the Philippine Journal of Science, Botany Section, Vol. 10, May 1916.

L. H. Dewey, discussed *Misleading names of plant fibers.*

There is more confusion in the common trade names of commercial fibers used in twine and cordage than there has been in recent years in the botanical names of plants. This results in errors in Government statistics, misunderstandings among dealers and manufacturers, and frequent monetary losses. The most serious trouble is due to the ambiguous use of the term hemp. This name was first used to designate the true hemp plant, *Cannabis sativa*, and the bast fiber obtained from that plant. It still has this specific meaning, but unfortunately it is also used in a generic sense as a substitute for the word fiber to designate nearly all long fibers, as manila hemp for abacá from the Philippines; sisal hemp for henequén from Yucatán, and sisal from East Africa; New Zealand hemp for phormium from New Zealand, and sunn hemp for sunn from India. The name of the country or definitive adjective is often omitted, leaving only the term hemp, which may mean any one of a dozen fibers.

Similar trouble is threatened by the use of the name sisal to designate not only the true sisal from *Agave sisalana*, but all other fibers from Agaves and Furcraeas, and the name jute to designate true jute and also all fibers similar to jute.

It is suggested that an authoritative list of fibers be published to correct these misleading and costly errors.

Mr. P. L. Ricker spoke of *The proposed Mt. Hamilton Botanical Garden*, which was still before Congress for consideration.

The regular meeting than adjourned and the annual meeting was held. The report of the Executive Committee showed the following facts concerning the activities of the preceding year: average attendance of the 8 regular meetings was 66; at a special meeting there were 110 present. Eighteen new

members were elected during the year. One member died. The total membership at this time is 161. The following officers were elected for the ensuing year: President, L. C. CORBETT; Vice President, H. L. SHANTZ; Recording Secretary, ROY G. PIERCE; Corresponding Secretary, R. KENT BEATTIE; Treasurer, W. W. GILBERT.

ROY G. PIERCE, *Recording Secretary.*

SCIENTIFIC NOTES AND NEWS

The ACADEMY'S list of one hundred popular books in science has been republished with notes by the American Library Association, under the title *Popular books in science, a reading list.* Copies will shortly be distributed to members of the ACADEMY. Additional copies may be purchased from the American Library Association, Chicago.

The Swedish Legation arranged a special lecture on the iron, steel, and timber industries of Sweden, which was given before the School of Foreign Service, Georgetown University on Friday, February 9. The lecturer was Dr. HARRY von ECKERMANN, the managing director of the Ljusne-Woxna Company, the largest iron works in Sweden.

The newest scientific organization in Washington is the Mineralogical Society which held its first meeting on Friday, February 23. *Space isomorphism in minerals* was discussed by Dr. E. T. WHERRY, and *Ptilolite and related zeolites* by Dr. W. T. SCHALLER. The secretary, Dr. W. F. FOSHAG, U. S. National Museum, will be pleased to hear from anyone interested in future meetings.

At the meeting of the Petrologists' Club on Tuesday, February 20, Messrs. L. H. ADAMS and E. D. WILLIAMSON discussed the *Elastic behavior of minerals and typical rocks.* The evidence as obtained by laboratory experiments and by seismological observations was briefly reviewed and its bearing on questions relating to the constitution of the earth considered.

A recent Act of Congress authorizes The Regents of the Smithsonian Institution to prepare preliminary plans for a suitable fireproof building with granite fronts, for the National Gallery of Art, including the National Portrait Gallery and the history collections of the U. S. National Museum.

The National Baird Memorial Committee met in the U. S. National Museum Saturday, February 3. This Committee was composed of delegates appointed by fifty-four scientific societies and institutions from the various parts of the country, and the following officers: Honorary President, Dr. WILLIAM H. DALL; President, Dr. CHARLES D. WALCOTT; Vice-Presidents, Mr. GEORGE R. AGASSIZ, Dr. FRANK W. CLARKE, Dr. STEPHEN A. FORBES, Dr. DAVID STARR JORDAN, Dr. EDWIN LINTON, Dr. EDWARD S. MORSE, Dr. HENRY FAIRFIELD OSBORN, Dr. ADDISON E. VERRILL and Dr. ROBERT S. WOODWARD; Secretary, Dr. PAUL BARTSCH.

The purpose of the meeting was to decide upon the form of the memorial or memorials to SPENCER FULLERTON BAIRD, former Secretary of the Smithsonian Institution, the virtual founder of the U. S. National Museum, the creator and head of the U. S. Fish Commission, and a prime mover in the establishment of the U. S. Geological Survey and the Bureau of American Ethnology.

The centenary of the birth of Professor Baird was celebrated in the evening in the auditorium of the National Museum. The following addresses were delivered: *Baird, the man*, Dr. WILLIAM DALL; *Baird and the Smithsonian Institution and its branches*, Dr. C. G. ABBOT; *Baird at Woods Hole*, Dr. EDWIN LINTON; *Baird and the fisheries*, Dr. DAVID STARR JORDAN; *Baird, the naturalist*, Dr. C. HART MERRIAM.

A public announcement was made of the report of the National Committee, as follows:

1. That Congress be memorialized to establish in the city of Washington a museum of fisheries and oceanography, with laboratories and a public aquarium, as a memorial to Spencer Fullerton Baird.

2. That there be established a fund for the encouragement of research and exploration in the directions in which Spencer Fullerton Baird was a leader.

3. It was the sense of the meeting that the name of Baird be given to the laboratory of the Bureau of Fisheries at Woods Hole, Massachusetts.

On Monday, February 19, the four hundred and fiftieth anniversary of the birth of Copernicus, a commemorative meeting was held in the U. S. National Museum. Dr. C. G. ABBOT gave a brief address on *Copernicus, his life and astronomical theory*.